BS EN 16327:2014

BSI Standards Publication

Fire-fighting — Positive-pressure proportioning systems (PPPS) and compressed-air foam systems (CAFS)

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National foreword

This British Standard is the UK implementation of EN 16327:2014.

The UK participation in its preparation was entrusted to Technical Committee FSH/17, Fire brigade equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Fire-fighting - Positive-pressure proportioning systems (PPPS) and compressed-air foam systems (CAFS)

Lutte contre l'incendie - Systèmes proportionneurs à pression positive (SPPP) et systèmes de mousse à air comprimé (CAFS)

Feuerwehrwesen - Druckzumischanlagen (DZA) und Druckluftschaumanlagen (DLS)

This European Standard was approved by CEN on 27 December 2013.

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Foreword

This document (EN 16327:2014) has been prepared by Technical Committee CEN/TC 192 “Fire and rescue service equipment”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2014, and conflicting national standards shall be withdrawn at the latest by August 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This standard is a type C standard as defined in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

The present document describes systems installed in a fire-fighting vehicle in order to improve the efficiency of fire-extinguishing processes. This is achieved by adding chemical solutions or foam concentrates (hereinafter collectively called foam concentrates) under pressure to the water being delivered by the fire-fighting centrifugal pump. Compressed-air may be injected in some cases to create the finished foam.

In addition to Class B fire-fighting operation, the described systems are used in Class A fire-fighting operation, with the aim to improve the adhesion, penetration and retention time of the fire-extinguishing agent on the burning material, thereby transferring more energy, and improving the cooling effect of the applied media. The object of using foams with fire extinguishing agents is to increase the effective contact area of the foam solution and to improve the adhesion to non-horizontal surfaces of the burning material, thereby increasing the time period in which heat is effectively transferred.

Another aim of the systems described is to improve, ease, and speed-up the use of foam concentrates during regular use in municipal or similar fire-fighting operations.

The following principles can be considered for mixing foam concentrates to water for fire-fighting purpose, where a) and b) is not part of this standard:

a) Venturi type inductors which create a vacuum to draw foam concentrate into the water stream. These inductors may be used as loose equipment, coupled into the hose line or permanently installed with a fire pump. A “Round the Pump” (RTP) system takes water from the pump discharge through a venturi device to draw foam concentrate into the pump- suction

NOTE These mobile systems are subject of a standard currently in preparation by CEN/TC 192/WG 8.

An RTP system may be used in conjunction with a PPPS if the full flow capacity of a fire pump is delivered as solution, and the full flow pump capacity exceeds the performance of the PPPS. All discharges on a fire pump will provide solution once an RTP is in operation. A RTP system will contaminate the fire pump and related installations with foam concentrate.

b) Premix (also known as batch mix) is a concept used in certain applications, where a measured amount of foam concentrate is added to the water in the vehicle tank, each time the water tank is filled. There is no special mixing technology used, the foam concentrate is simply poured into the water tank.

This principle is typically used for seasonal fire- fighting operation (forest and wildland) where the equipment is flushed, serviced and stored away once the season is over.

c) Positive-pressure proportioning systems (PPPS) use a foam concentrate pump to inject the foam agent into the water stream at a pressure higher than the water pressure. A PPPS typically provides solution to designated discharges on a fire pump.

The systems considered in this standard were originally designed as “Class A foam proportioners” to handle low injection rates and variable flows. However, they can be used with any other suitable foam concentrate. Recent developments on foam concentrates allow low injection rates for Class B fire- fighting as well.

PPPS do not contaminate the fire pump and water installations with foam concentrate.

Once a water concentrate solution is produced, the finished foam will be created by inducting air at the fire-fighting nozzle as a “Nozzle Aspirated Foam System” (NAFS) or as

d) Injecting compressed-air as a “Compressed-air Foam System” (CAFS).

The system designations mentioned in this standard refer to typical fire-fighting nozzle flow rates or to a combination of such nozzles used at one time.

Water foam solution produced by the PPPS can also be delivered through common non aspirating branch pipe in order to use water with reduced surface tension.

This European Standard considers PPPS and CAFS to be installed in conjunction with a fire-fighting centrifugal pump according to EN 1028 (all parts) or EN 14710 (all parts).

PPPS and CAFS may be operated simultaneously whilst delivering plain water from a fire pump.

Information on environmental impact of fluorine-containing foam extinguishing agent:

Poly-and perfluorinated chemicals (Perfluorochemicals PFC) can be detected by living organisms, in water and sediments. In nature they are very difficult or impossible to degrade. Therefore, the EU has banned the marketing and use of Perfluoroctansulfonate (PFOS) $C_8F_{17}SO_2X$ since 2008-06-27 by EU-Directive 2006/122/EC. See also EU-REACH-Regulation ECV 1907/2006. For fire extinguishing agent based on PFOS, a use period has expired on June 2011 (provided that they were already on the market before December 2006).

Only PFOS containing fire-fighting foaming agents are affected by the EU ban. However, other poly-and perfluorinated chemicals (PFCs) may have a long term influence on living organisms and the environment, as well. It is therefore necessary to carefully evaluate if PFC-containing foaming agents are required for the particular fire-fighting operation in question. Training with PFCs should be avoided or reduced to the absolute minimum. General procedures of foam application may be developed with “Training Foam” agents, thereby causing less impact on the environment.

The use of PFCs for fire-fighting and training operation may require the containment and proper disposal of any run-off, depending on local regulations.

While the use of the aforementioned foam agents (PFCs) may be required for Class B fire-fighting operations, the use of Class A, biodegradable foam agents should be considered for Class A fire-fighting operations, as it will reduce the environmental impact of the fire-fighting operation significantly.

Any tests producing finished foam, as described in this standard, should be kept to the minimum required and use an environmentally friendly foam agent whenever possible.

Testing and training should use appropriate sites, where run-off can be controlled in accordance with local regulations and will not contaminate any open water-sources or the water-table.

The Material-Safety Data Sheet (MSDS) for each foam agent being used should be considered for decisions in relation to the environmental impact. Consultations with local authorities, organizations and agencies may be required to ensure use and disposal.

The objective of using foam for any fire-fighting operation is to reduce knock-down time and the amount of combustion-products released while the fire is burning. Using foam to improve the efficiency of the fire-fighting operation will consume less water and reduce the amount of contaminated run-off. These factors should be balanced against any potential impact from the foam-agent being used.

1 Scope

This European Standard applies to systems which add a foam concentrate to the water discharged from a fire-fighting centrifugal pump either:

a) by a positive-pressure proportioning system (PPPS) alone, or

b) together with compressed-air by means of a compressed-air foam system (CAFS).

In both cases pressure is applied to the foam concentrate in order to permit continuous operation. Such systems are permanently installed in fire-fighting vehicles. Permanently installed or fixed systems in buildings or structures are not covered by this European Standard.

NOTE 1 This European Standard is intended to be used in conjunction with EN 1846–2 and EN 1846–3.

This European Standard applies to the design, manufacture and operation of such systems. This European Standard deals with all significant hazards, hazardous situations and events relevant to PPPS and CAFS when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacture (see Clause 4).

NOTE 2 Performance requirements are also given (see Clause 7).

This European Standard applies to systems which are used at ambient temperatures ranging from −15 °C to +35 °C as stated in EN 1846-3.

For systems to be used at temperature outside this temperature range, the particular temperature range should be specified by the user and the manufacturer should determine by a risk assessment any need for additional precautions.

This European Standard does not apply to the technical safety requirements concerning the design and manufacturing of drives, auxiliary equipment, sources of energy or pumps. Furthermore, this European Standard does not deal with special hazards arising from the particular conditions under which these systems are used, for example:

a) handling of any equipment, devices etc. which are connected to the system or are joined to it (e.g. handling of branch pipes/nozzles and pressure hoses);

b) events specific to the location where the system is set up (e.g. on public roads);

c) decommissioning and disposal;

d) operation without supervision;

e) immunity against electromagnetic fields and electrostatic discharge.

Hazards relating to any kind of mechanical, electrical, hydraulic, pneumatic and other equipment dealt with by the respective standards for such equipment are not covered by the present standard. References to the relevant standards are made wherever such standards exist and whenever necessary.

This European Standard does not deal with the hazards arising from noise.

NOTE 3 EN 1846–2 covers hazards arising from noise for the complete vehicle.

This European Standard does not deal with hazards related to handling foam concentrates or contact with.

NOTE 4 Additive installation is dealt with in EN 1846–3.

This European Standard is not applicable to systems which are manufactured before the date of publication of this European Standard by CEN.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 349, *Safety of machinery - Minimum gaps to avoid crushing of parts of the human body*

EN 547-2, *Safety of machinery - Human body measurements - Part 2: Principles for determining the dimensions required for access openings*

EN 547-3, *Safety of machinery - Human body measurements - Part 3: Anthropometric data*

EN 659, *Protective gloves for firefighters*

EN 894-1, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 1: General principles for human interactions with displays and control actuators*

EN 894-2, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 2: Displays*

EN 894-3, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 894-4, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 4: Location and arrangement of displays and control actuators*

EN 953, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards*

EN 1005-3, *Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation*

EN 1028-1, *Fire-fighting pumps - Fire-fighting centrifugal pumps with primer - Part 1: Classification — General and safety requirements*

EN 1028-2, *Fire-fighting pumps - Fire-fighting centrifugal pumps with primer - Part 2: Verification of general and safety requirements*

EN 1568-1, *Fire extinguishing media - Foam concentrates - Part 1: Specification for medium expansion foam concentrates for surface application to water-immiscible liquids*

EN 1568-3:2008, *Fire extinguishing media - Foam concentrates - Part 3: Specification for low expansion foam concentrates for surface application to water-immiscible liquids*

EN 1846-2, *Firefighting and rescue service vehicles - Part 2: Common requirements - Safety and performance*

EN 1846-3:2013, *Firefighting and rescue service vehicles - Part 3: Permanently installed equipment - Safety and performance*

EN 14466:2005+A1:2008, *Fire-fighting pumps - Portable pumps - Safety and performance requirements, tests*

CEN/TS 15989, *Firefighting vehicles and equipment - Symbols for operator controls and other displays*

EN 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1)*

EN 60529, *Degrees of protection provided by enclosures (IP code) (IEC 60529)*

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1)*

EN 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2)*

EN 61310-3, *Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators (IEC 61310-3)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13732-1, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces (ISO 13732-1)*

EN ISO 13732-3, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 3: Cold surfaces (ISO 13732-3)*

EN ISO 13857, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857)*

ISO 7000, *Graphical symbols for use on equipment - Registered symbols*

3 Terms and definitions

For the purpose of this document, the terms and definitions in EN 1028-1 and EN 1028-2 and the following apply.

3.1
positive-pressure proportioning systems
PPPS
system in which a foam concentrate under pressure, at a dosage rate proportional to the flow rate of the water, is continuously added to the water being discharged from a fire-fighting centrifugal pump

3.2
compressed-air foam system
CAFS
system in which a foam concentrate and air are continuously added, under pressure, to the water being discharged from a fire-fighting centrifugal pump

Note 1 to entry: It is assumed that in a compressed-air foam system a positive-pressure proportioning system adds the foam concentrate continuously to the water being discharged from a fire-fighting centrifugal pump at a dosage rate proportional to the flow rate of the water.

3.3
foam solution
mixture of water and foam concentrate

Note 1 to entry: PPPS has no influence on the aspiration. Therefore, test procedures in this standard only consider the accuracy of dosage. Finished foam may be tested as described in EN 1568 (all parts) if necessary.

3.4
wet foam
operation defined by a nominal solution/air ratio between 1:3 and 1:10, being mixed in the system, with finished foam delivered from the system with an expansion ratio between 4 and 11

3.5
dry foam
operation defined by a nominal solution/air ratio greater than 1:10, being mixed in the system, with finished foam delivered from the system with an expansion ratio greater than 11

Note 1 to entry: CAFS has an influence on the production of the finished foam. Finished foam from CAFS is tested as described in Annex D, which is based on EN 1568–3 principles.

Note 2 to entry: Typically all finished foam produced by CAFS falls under “Low Expansion Foams” as described in EN 1568–3.

3.6
operating range
range (of conditions) specified by the manufacturer of a system and within which the system can be operated without limitations while achieving the designated performance characteristics

3.7
Delivery rates
NOTE Delivery rates are stated in litres per minute [l/min].

3.7.1
foam solution delivery rate
Q_w
volume (of water plus foam concentrate) delivered per unit of time by a system

Note 1 to entry At proportioning ratios of up to 1 % the difference between water delivery rate and foam solution delivery rate can be neglected.

3.7.2
nominal foam solution delivery rate
foam solution delivery rate at the nominal delivery pressure of the fire-fighting centrifugal pump

3.7.3
air delivery rate
volume of air, in ambient condition, that is fed into a compressed-air foam system per unit of time

Note 1 to entry: For determination of flow-rate characteristics see ISO 6358.

Note 2 to entry: While inside the system the air-volume is compressed according to the pressure applied. Once leaving the system from the nozzle to atmosphere the air expands to its normal volume again.

3.8
proportioning ratio
amount of foam agent added to water given as a percentage

3.9
Volume definitions

3.9.1
air/foam solution volume ratio
relationship between parts of liquid (solution) and parts of air (at atmospheric pressure) being mixed together in a CAFS mixing device

Note 1 to entry: The measurement units are l/min.

3.9.2
flushing procedure
procedure described by the manufacturer to ensure that the foam proportioning system and associated pipework on the fire-fighting centrifugal pump to the discharge connection is adequately flushed of foam concentrate and solution to avoid any damage

EXAMPLE Corrosion.

3.10
operating pressure of the compressed-air foam system
p
pressure, specified by the compressed-air foam system manufacturer, at the system input connection at which all performance and safety requirements are met

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery and which necessitates action to eliminate or reduce the risk.

The significant hazards are given in Table 1, which is based on the principles of EN ISO 12100:2010, Annex B. Also shown are the subclause references to the safety requirements and/or protective measures in this document, if applicable.

When the present standard was compiled, it was assumed that:

a) the systems are operated by properly trained personnel only;

b) components not subject to particular requirements are:

   1) designed according to standard engineering practice and calculation methods, including due consideration to all modes of failure;

   2) designed to be mechanically robust;

   3) made of materials with strength and quality meeting the requirements of this European Standard;

   4) manufactured of flawless materials.

c) no hazardous materials (e.g. asbestos) are used;

d) components are kept in good condition in order to maintain the required characteristics;

e) the structural dimensions of load-bearing elements ensure safe operation and remain fully operational even after testing;

f) fault-free operational functioning of the system is ensured within the specified ambient temperature ranges;

g) manufacturers and operators of the system have agreed upon the system's characteristics and operating conditions.

Table 1 — List of significant hazards

No.	Hazard	Clause/ Subclause in this European Standard
1	Mechanical hazards due to: a) machine parts or work-pieces, e.g.: 1) shape; 2) relative location; 3) mass and stability (potential energy of elements which may move under the effect of gravity); 4) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion); 5) inadequacy of mechanical strength. b) accumulation of energy inside the machinery, e.g.: 1) elastic elements (springs); 2) liquids and gases under pressure; 3) the effect of vacuum.	
1.1	Crushing hazard	6.1.2.1
1.2	Shearing hazard	6.1.2.1
1.3	Cutting or severing hazard	6.1.2.1
1.4	Entanglement hazard	6.1.2.1
1.5	Drawing-in or trapping hazard	6.1.2.1
1.6	Impact hazard	6.1.2.1
1.7	High pressure fluid injection or ejection hazard	6.1.2.2, 6.2
2	Electrical hazards due to:	
2.1	Thermal radiation or other phenomena such as the projection of molten particles and chemical effects from short circuits, overloads, etc.	6.1.3
3	Thermal hazards, resulting in:	
3.1	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	6.1.4
4	Hazards generated by vibration	6.1.1
5	Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery	6.1.2.3
5.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	6.1.2.3
5.2	Fire or explosion hazard	6.1.2.2

6	Hazards generated by neglecting ergonomic principles in machinery design as, e.g. hazards from:	
6.1	Unhealthy postures or excessive effort	6.1.5
6.2	Neglected use of personal protection equipment	6.1.1
6.3	Inadequate local lighting	6.1.1
6.4	Human error, human behaviour	6.1.5, 6.1.6
6.5	Inadequate design, location or identification of manual controls	6.1.5
6.6	Inadequate design or location of visual display units	6.1.5
7	Combination of hazards	6.1, 6.2
8	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:	
8.1	Failure/disorder of the control system	6.1.6
8.2	Restoration of energy supply after an interruption	6.1.1
8.3	External influences on electrical equipment	6.1.6
8.4	Other external influences (gravity, wind, etc.)	6.1.1
8.5	Errors in the software	6.1.6
8.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities)	6.1.6
9	Failure of the power supply	6.1.8
10	Failure of the control circuit	6.1.6
11	Break-up during operation	6.1.2
12	Ejected objects or fluids	6.1.2.2, 6.2
13	Slip, trip and fall of persons (related to machinery)	6.1.1
14	Relating to the travelling function:	
14.1	Movement when starting the engine	6.1.1
14.2	Insufficient ability of machinery to be slowed down, stopped and immobilized	6.1.9
15	Linked to the work position (including driving station) on the machine:	
15.1	Exhaust gases/lack of oxygen at the work position	6.1.1
15.2	Fire (flammability of the cab, lack of extinguishing means)	6.1.1
15.3	Mechanical hazards at the work position: a) fall of objects, penetration by objects; b) break-up of parts rotating at high speed.	6.1.2
15.4	Inadequate lighting	6.1.1
15.5	Vibration at the work position	6.1.1
16	Due to the control system:	
16.1	Inadequate location of manual controls	6.1.5
16.2	Inadequate design of manual controls and their mode of operation	6.1.5, 6.1.6
17	From handling the machine (lack of stability)	6.1.1
18	Due to the power source and to the transmission of power:	
18.1	Hazards from the engine and the batteries	6.1.1

18.2	Hazards from transmission of power between machines	6.1.1
18.3	Hazards from coupling	6.1.1, 6.1.7
19	From/to third persons:	
19.1	Lack or inadequacy of visual or acoustic warning means	6.1.1
20	Insufficient instructions for the driver/operator	6.1.1
21	Mechanical hazards and hazardous events:	
21.1	from insufficient mechanical strength of parts	6.1.2.4
21.2	from abnormal conditions of assembly/testing/use/maintenance	6.1.7
22	Falling of persons from vehicle	6.1.1

5 Classification and designation

5.1 Classification and designation of positive-pressure proportioning systems (PPPS)

Positive-pressure proportioning systems (PPPS) are classified according to the criteria shown in Table 2, whereby a dosage ratio of between 0,5 % and 1 % is to be assumed in all cases.

Table 2 – Classification of positive-pressure proportioning systems (PPPS)

Short designation	**Guarantee point 1** nominal foam solution delivery rate at nominal dosage ratio of 1 % l/min	**Guarantee point 2** foam solution delivery rate at dosage ratio of 0,5 % at least l/min
PPPS 200	200	100
PPPS 400	400	100
PPPS 800	800	100
PPPS 1600	1600	200
PPPS 2400	2400	800
NOTE 1 The values stated for guarantee point 1 are minimum requirements. NOTE 2 The values stated for guarantee point 2 specifies the values above which foam concentrate is to be added. This ensures that an adequate dosage is achieved even for delivery rates lower than the nominal delivery rate (e.g. if only one nozzle/branch pipe is utilized).		

Positive-pressure proportioning systems (PPPS) which conform to this standard shall be designated as follows:

a) long designation;

b) number of this European standard EN 16327;

c) short designation PPPS;

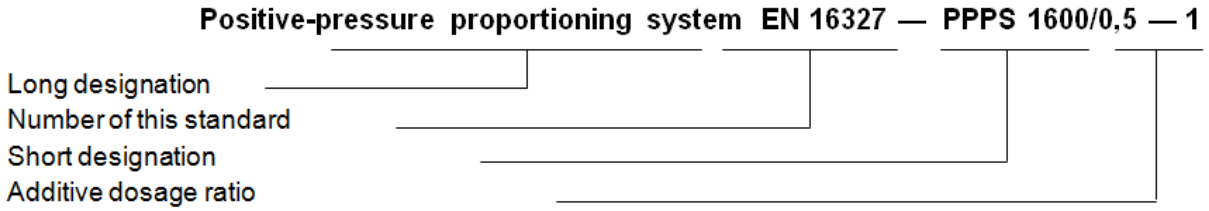
d) additive dosage ratio range,

1) either by stating the minimum and the maximum dosage ratios or

2) by stating a fixed dosage ratio value.

Where positive-pressure proportioning systems with higher nominal delivery rates and/or other operating ranges are required, the manufacturer and the user are to reach a special agreement on the characteristics of these.

EXAMPLE Designation of a positive-pressure proportioning system (PPPS) in accordance with this standard (EN 16327), a nominal fire-extinguishing-agent delivery rate of 1 600 l/min and a minimum and maximum dosage ratio that can be adjusted within a range of 0,5 % to1 % by the operator:



5.2 Classification and designation of compressed-air foam systems (CAFS)

Compressed-air foam systems (CAFS) are classified according to the criteria shown in Table 3 and by the positive-pressure proportioning system (PPPS) used in conjunction with them (see Table 2).

Table 3 – Classification of compressed-air foam systems (CAFS)

Short designation	**Guarantee point 1** Nominal foam solution delivery rate at nominal proportioning rate of 1 % l/min	**Guarantee point 2** Nominal air delivery rate at normal condition l/min
CAFS 200	200	600
CAFS 400	400	1 200
CAFS 800	800	2 400
CAFS 1600	1 600	4 800

Where compressed-air foam systems with higher volume delivery rates are required, the manufacturer and the customer are to reach a special agreement on characteristics of these.

The nominal air delivery rate from the compressor shall comply with Table 3. The nominal foam solution delivery rate shall be as required by the customer but at least it shall be possible to generate wet foam (see 3.4).

NOTE See sample diagram showing the operating range of a compressed-air foam system (CAFS) in Annex C.

Compressed-air foam systems (CAFS) conforming to this standard are to be designated as follows:

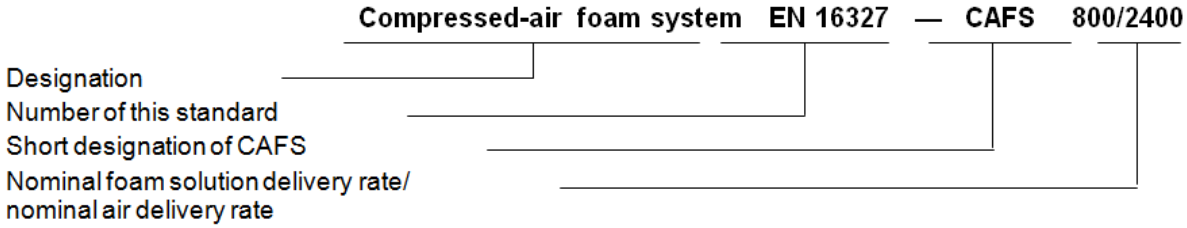
a) long designation;

b) number of this European standard EN 16327;

c) short designation CAFS;

d) nominal foam solution delivery rate/nominal air delivery rate.

EXAMPLE Designation of a compressed-air foam system (CAFS) in accordance with this standard (EN 16327), a nominal foam solution delivery rate of 800 l/min and a nominal air delivery rate of 2 400 l/min (1:3 ratio):



In all cases, a positive-pressure proportioning system (PPPS) capable of achieving at least the foam solution delivery rate specified in Table 2 shall be used.

6 Safety requirements and/or protective measures

6.1 Safety requirements applying to all systems

6.1.1 General

Conformity to all requirements shall be verified by the measures described (type test).

In addition, each system put on the market shall meet the requirements of this document that are indicated by “(IND)” in the verification procedures (standing for individual test) before dispatch.

NOTE A guideline for acceptance testing and inspection on delivery of a system is given in informative Annex A.

The system shall still be in a working condition and in compliance with this standard after completion of the tests.

Positive-pressure proportioning systems (PPPS) and compressed-air foam systems (CAFS) shall comply with the safety requirements and/or protective measures of this clause. In addition, the provisions of EN 1846-2 and EN 1846-3 also apply to positive-pressure proportioning systems and compressed-air foam systems permanently installed in fire-fighting vehicles.

In addition, the systems shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards (e.g. sharp edges), which are not dealt with by this document.

General requirements regarding electromagnetic compatibility (EMC) can be met by applying the corresponding clauses of EN 55012 (CISPR 12) on interference emissions, provided that the system is only powered by internal-combustion engines, or by applying the generic standards EN 61000-6-3 for interference emissions and EN 61000-6-2 for immunity to disturbance.

In order to check whether all hazards of a system have been dealt with in this clause, the manufacturer should carry out a risk assessment for the system to determine any additional hazards not covered by this European Standard. When additional hazards are identified, it is the responsibility of the manufacturer to incorporate suitable protective measures to reduce the risk from these hazards to an acceptable level.

In order to minimize the risks associated with operating and installing the system, information for user/operating instructions in accordance with Clause 9 shall be provided.

Verification: inspection of documents.

Marking shall be as specified in Clause 10.

Verification: visual inspection (IND).

6.1.2 Mechanical equipment

6.1.2.1 Moving parts

Access to moving parts of machinery (e.g. fans, drive belts, chain drives) shall be prevented during normal operation. If necessary to achieve this requirement the following shall be provided:

a) fixed guards as defined in EN 953 complying with the safety distances as defined in EN ISO 13857;

b) minimum clearance at the end of a motion sequence as defined in EN 349.

Verification: visual inspection (IND).

6.1.2.2 Components under pressure

The provisions of EN 1846-3:2013, 5.2.2.1.1 shall apply to all components subjected to the discharge pressure of the fire-fighting centrifugal pump.

Verification: function testing (IND).

Prevention of over-pressurization shall be ensured.

Verification: design inspection.

Internal pressure of the system shall be relieved completely.

Verification: function testing (IND).

6.1.2.3 Materials and sealing system

In addition to EN 1846-3:2013, 5.2.3.1 the design, the materials used and the sealing systems shall be fully compatible with the media being handled and shall prevent any hazards that may result from the escape of such media. When assessing said material/seal/media compatibility, due consideration shall be given to the type of media as well as of temperatures and pressures to be experienced.

Verification: By manufacturer's attestation of the construction and materials.

6.1.2.4 Parts and components

All parts and components and their installation shall conform to generally accepted sound engineering practice. If the system has its own engine, the provisions of EN 14466:2005+A1:2008, 5.1.6 shall apply.

Verification: By manufacturer's attestation of the construction and materials.

6.1.3 Electrical equipment

Electrical equipment shall conform to EN 60204-1.

Design measures for the installation of instrumentation and control equipment shall ensure that these components cannot be damaged by water, foam solutions and/or mixtures of foam solutions under any conditions including filling the onboard water and foam tanks.

EXAMPLE Installation of instrumentation and control equipment in enclosures.

Protection of the instrumentation and control equipment shall be at least equivalent to IP 54 as defined in EN 60529.

Verification: visual inspection (IND) and design inspection.

6.1.4 Thermal hazards

With regard to the minimum and maximum surface temperature during operation and transportation, the provisions of EN ISO 13732-1 (hot surfaces) and EN ISO 13732-3 (cold surfaces) shall apply under the following conditions:

a) it shall be assumed that handles be touched for a duration of 1 min;

b) for surfaces which might be contacted unintentionally, a contact time of 0,5 s shall be assumed and

c) for surfaces which are contacted intentionally other than handles, e.g. operating elements, a contact time of 4 s shall be assumed.

Information for users (see Clause 9) shall contain details on how hazards that might cause burns or frost-bite can be reduced (e.g. by wearing protective gloves for fire-fighters), as well as details on how to avoid igniting objects in the vicinity.

Verification: A temperature analysis of the system shall be carried out in accordance with EN ISO 13732-1 *and* EN ISO 13732-3*. Measure the temperatures after operating at nominal performance when stabilized.*

6.1.5 Ergonomic design principles

Indicators, displays and operating elements shall conform to the design principles specified in EN 894 (all parts). The requirements for arranging and operating indicators, displays and controls are specified in EN 61310 (all parts).

Pictograms which are not covered by EN 61310 (all parts) shall conform to CEN/TS 15989 and ISO 7000.

Equipment for starting up operation shall be grouped together as part of the fire-fighting centrifugal pump's operating panel. Deviations from this requirement shall be agreed between manufacturer and customer.

All instruments shall be visible from the operator's position (as defined in EN 1846-2) and be easily readable even in adverse light conditions. The installation shall comply with EN 1846-2 and EN 1846-3.

Manual operating equipment and other control elements shall be easy to reach and to operate when wearing protective gloves for fire-fighters as specified in EN 659 and without having to apply excessive force taking into account the force limits for machinery operation given in EN 1005-3.

The number of switching operations shall be kept to a minimum and the control elements shall be arranged according to the operating sequence in such a manner that operating errors are avoided as far as possible.

Verification: visual inspection and/or function testing (IND).

6.1.6 System failure and continuation of on-going fire-fighting operations

Safety-relevant failures in the system shall be clearly indicated by for example visual indicators on the fire-fighting centrifugal pump's operating panel.

The system and the associated installation shall then remain in a safe condition to ensure that further extinguishing operation with water with sufficient water pressure and water flow at the discharge is maintained.

Following modes shall be provided in case of system failures or operator error:

— Failure of CAFS: continuous operation with foam solution via PPPS;

— Failure of PPPS: continuous operation with water via fire-fighting pump.

Complete blockage of the water flow by malfunction of PPPS or CAFS shall be avoided by appropriate means.

If CAFS air injection fails, any throttling of foam solution flow rate shall be automatically cancelled.

To permit safe continuation of a fire-fighting operation, the water flow rate shall meet the requirements in Table 3.

Verification: design inspection, function test and review of the information for use.

6.1.7 Maintenance

Positive-pressure proportioning systems and compressed-air foam systems shall be designed in accordance with EN 547-2 and EN 547-3 in order to allow maintenance (see Clause 9).

NOTE For maintainability requirements see EN ISO 12100.

Verification: visual inspection (IND) and inspection of the information for users.

6.1.8 Protection against over-speed

If necessary, the system shall have a means of preventing maximum speed being exceeded. When the system is switched off, the fire-fighting centrifugal pump shall be usable without restrictions and with no user intervention.

Verification: function testing (IND).

6.1.9 Shutdown device

The operating control station shall be equipped with a device that serves to switch off the system with a single operating step (see EN 1846-3:2013, 5.2.1.2).

Verification: function testing (IND).

6.1.10 Injection of foam concentrates

The system shall not inject foam concentrates until the pump is not delivering water.

Verification: design inspection and function testing.

6.2 Additional safety requirements for compressed-air foam systems (CAFS)

6.2.1 Air injection is permitted only if there is water flow as well as additive flow and the system pressure is higher than 1 bar (0,1 MPA).

Verification: function testing.

6.2.2 The maximum operation pressure while using CAFS from the designated delivery outlets shall not exceed 10 bar (1,0 MPa). Higher pressures for specific applications may be agreed between customer and manufacturer.

NOTE The 10 bar limitation is to avoid excessive reaction forces on the nozzles in operation as well as any other potential hazards implied by compressed-air. Common operating pressures whilst using CAFS are approx. 7 bar (0,7 MPa) and are sufficient for all potential applications.

All components subject to pressure shall meet the requirements in accordance with EN 1846-3, EN 1028 (all parts) and EN 14710 (all parts).

Verification: design inspection.

7 Performance requirements

7.1 Performance requirements applying to all systems

7.1.1 Conformity with all requirements shall be verified by the measures described in this European Standard. Ensure that each system put on the market meets the requirements of this document before dispatch.

NOTE 1 This verification is indicated as “IND”, standing for individual test, in the following.

NOTE 2 A guideline for acceptance testing and inspection of delivery is given in informative Annex A.

The system shall still be in a working condition after completion of the tests.

7.1.2 Systems shall be capable of 6 h continuous operation at the nominal delivery rate and the maximum additive dosage rate specified by the manufacturer.

Verification: function testing, whereby water may be used instead of a foam concentrate.

7.1.3 It shall be possible to switch on the system in order to add foam concentrate while the fire-fighting centrifugal pump is running, without interrupting water delivery.

Verification: function testing, whereby water may be used instead of a foam concentrate.

7.1.4 Mixing of incompatible additives from installed tanks shall be avoided.

Verification: design inspection.

7.1.5 It shall be ensured that any media is excluded from components of the system for which it was not intended.

Verification: design inspection.

7.1.6 In addition to EN 1846-3:2013, 5.3.3, the system shall be drained completely (among other things, for frost protection) at one easily accessible point.

Verification: function testing (IND).

7.1.7 If the foam concentrate dosage rate and/or the air/foam solution volume ratio can be adjusted by the operating personnel, the selected setting shall be suitably indicated.

Verification: visual inspection (IND) and function testing.

7.1.8 The dosage rate may be adjustable continuously or incremental. Minimum and maximum adjustable rates shall be defined. If the adjustment is incremental, the increments shall be defined as well.

Increments up to 0,1 % are still considered continuous.

Verification: visual inspection (IND), design inspection and documentation inspection.

7.1.9 The operating range of a system in terms of water flow and achievable dosage rates at a specific flow shall be defined. At nominal flow according to 5.1, Table 2, guarantee point 1, the achievable dosage ratio shall be 1 %. It shall be also possible to reduce the dosage rate to 0,5 % or lower.

Verification: testing by measurement.

NOTE Annex B is providing an example how the operating-range may be defined.

Other dosage ranges or fixed settings are to be agreed upon by the manufacturer and the user.

7.1.10 By means of a special indicator or display, the operating panel of the fire-fighting centrifugal pump shall indicate when the set dosage ratio can no longer be achieved by increasing the delivery rate through the system or by increasing the dosage rate when the water delivery rate is too high.

If a system is technically designed so that the delivery rate through the system cannot lead to the dosage rate exceeding the operating range of the pump feeding the foam concentrate, this indicator can be omitted.

Verification: visual inspection (IND) and design inspection.

7.1.11 Within the operating range and at a foam solution delivery pressure of between 4 bar (0,4 MPA) and 10 bar (1,0 MPA), the deviation from the set dosage rate shall not exceed:

a) 0 % to +40 %for dosage ratios up to 1 %,

b) 0 % to +30 % for dosage ratios between 1 % and 3 %.

NOTE In operation, dosage rates of less than 1 % are typically used for Class A fires. Dosage-rates of 1 % and higher are typically required for Class B fires. Under-dosage could affect the efficiency of the foam-application, which again may raise safety-concerns. Over-dosage is not safety-relevant but may prevent the generation of wet water (water with the addition of wetting agent) and increases the cost.

If the party ordering the system requests higher dosage ratios, maximum permitted deviations from the preselected higher dosage ratios are to be agreed upon with the system manufacturer/supplier.

Verification: testing by measurement during a defined cycle according to the normal use of the vehicle.

7.1.12 When the system is ready for operation, it shall not take more than 10 s to achieve the performance specified as guarantee point 2 in Table 2 at the pressurized media outlets to which the fire-fighting hoses are connected.

NOTE The term “ready for operation” is understood to mean that the system is completely filled with foam concentrate. The term “guarantee point” is generally used in pump technology and is not understood as guarantee condition in a contract.

Verification: testing by measurement.

7.1.13 It shall be possible to isolate and empty permanently-installed foam concentrate containers in order to permit maintenance work.

Verification: visual inspection (IND) and design inspection.

7.1.14 Filter(s) shall be fitted to prevent foreign matter entering the additive injection pump. This filter shall be easily cleanable and, if necessary, easily accessible and dismountable by the operator. If a tool is necessary it shall be attached close to the filter.

Verification: design inspection and visual check.

7.1.15 Once the flushing procedure according to 3.9.2 is completed, all parts of the system up to the discharge coupling shall be free from foam concentrate in such terms that damage to system parts are avoided. According to EN 1846-3:2013, 5.2.3.1.2, all parts of the technical equipment for foaming concentrate in the fire fighting vehicle shall be corrosion proof in respect of the foaming concentrate. If applicable, flushing procedures (time, volume, pressure etc.) shall be specified in the information for users as necessary.

Verification: inspection of the information for users.

7.1.16 In addition to EN 1846-3:2013, 5.3.3.4, the type and number of the supplied pressure outlets (operable, simultaneously or individually) shall be agreed between manufacturer and user.

Verification: visual inspection (IND) and design inspection.

7.1.17 The nominal performance p_{a1} and Q_1 (sum of water used for water outlet and PPPS/CAFS outlet) according to EN 1846-3:2013, 5.3.2.1 of the fire pump installed in the fire appliance shall not be limited by the use of the PPPS or CAFS.

Verification: function testing.

7.2 Additional performance requirements for positive-pressure proportioning systems (PPPS)

The pressure loss across the system when operated at the nominal delivery rate shall not exceed 2,5 bar (0,25 MPA). Accurate foam concentrate injection proportional to water flow shall always be achieved within the working range of the system.

Verification: determine the pressure loss by measurement in the core system.

7.3 Additional performance requirements for compressed-air foam systems (CAFS)

7.3.1 The operating range of the system shall be defined in terms of solution flow, air flow and adjustable ratios as defined in 3.4 and 3.5.

At the nominal CAFS delivery rate as specified in 5.2 and at the operating pressure recommended by the manufacturer, the finished foam shall be wet foam.

The ratio adjustment may be designed as permanent, user defined pre-sets, incremental or continuous, within the range defined in 3.4 and 3.5. Permanent settings or pre-sets shall be determined by the system manufacturer/supplier after consultation with the customer. If applicable, increments in changing ratios shall be defined by the manufacturer.

If the system has more than one mixing/adjusting device, it shall be clearly defined which values are available in total and from each individual device.

A single mixing/adjusting device may distribute the fire extinguishing media to several outlets.

NOTE 1 Examples of typical mixing device layouts are given in Annex E.

The operating ranges for dry foam and wet foam shall be determined by the system manufacturer/supplier after consultation with the customer. If desired, permanent settings are permissible.

NOTE 2 An example for the operating range of a compressed-air foam system (CAFS) is given in Annex C.

The expansion ratio of the finished foam according to EN 1568-1 shall be determined in accordance with Annex D.

Verification: testing in accordance with Annex D (IND).

7.3.2 As a minimum requirement, a compressed-air foam system shall be able to generate wet foam as described in 3.4.

If the customer so desires, a means of varying foam consistency between wet foam and dry foam may be provided.

Verification: function testing.

7.3.3 If there is a possibility of water accumulating in the air system, a means of removing it shall be provided.

Verification: visual inspection (IND).

7.3.4 A visual and audible warning device indicating compressor overheat shall be installed.

Verification: visual inspection (IND) and design inspection.

7.3.5 When discharging compressed-air foam there shall be no sudden pressure surges at the outlet nozzle.

Verification: function testing.

8 Type test report

The report of type approval tests of a system shall contain at least the following information:

a) manufacturer’s name or trademark;

b) reference to the present standard;

c) designation of the system;

d) manufacturing number and year of manufacture of the system on which type testing was carried out;

e) operating range diagram;

f) confirmation that the system conforms to this standard;

g) ambient temperature during the test;

h) additive product(s) used during the test;

i) date of test;

j) name and function of the person(s) conducting the tests.

9 Information for users

9.1 General

Information for users shall be compiled in accordance with EN ISO 12100:2010, 6.4 and be supplied together with the respective positive-pressure proportioning system or compressed-air foam system (collectively designated “system” below).

9.2 Symbols, warning symbols and warning notes

Pictograms shall conform to EN 61310-2. Pictograms which are not covered by EN 61310-2 shall conform to CEN/TS 15989 and ISO 7000.

NOTE Safety and/or health signs are mentioned in EC Directive 92/58/EEC.

9.3 Accompanying documents

9.3.1 General

The instruction handbook shall conform to 9.3 and EN ISO 12100:2010, 6.4.5 and shall be provided together with the system.

9.3.2 Contents

9.3.2.1 General information

The operating instructions shall contain the following general information:

a) application range and limits of use as intended (e.g. note that the system is not intended for use in potentially explosive atmospheres), including specification of all ambient conditions at the place of deployment;

b) details on the system, including:

   1) operating instructions;

   2) manufacturer’s name or name of their authorized representative;

   3) designation, type, size;

   4) revision number and/or revision date of the operating instructions;

   5) warnings to prevent foreseeable misuse;

c) necessary personal protective equipment (e.g. the need to wear protective gloves in accordance with EN 659).

9.3.2.2 System description

The operating instructions shall contain information on the following:

a) general description;

b) ambient temperature range for system operation;

c) design, mode of operation and system performance, including main specifications (e.g. Figure B.1, materials, draining, maintenance items);

d) following information about the properties of the foam concentrate that shall comply with to be used with the system:

   1) proportioning;

   2) viscosity.

e) information concerning the hoses (e.g. diameter, length) and the nozzles to be used;

f) maximum operating pressure (limit pressure $p_{a\ lim}$; see EN 1028-1);

g) information on operating elements, indicators and displays;

h) design, operating principle and use of protective devices;

i) additional description of accessories;

j) cutaway or exploded view drawings of the system as required by party ordering the system;

k) information on the electrical equipment.

9.3.2.3 Commissioning, operating and decommissioning

The operating instructions shall include the following instructions for commissioning, operating and decommissioning the system:

a) technical documents, including:

   1) measuring points and piping diagram (e.g. piping and instrumentation flow diagram);

   2) overview of recommended lubricants;

b) settings of control and monitoring equipment, including:

   1) function tests,

   2) setting values;

c) instructions for putting the system into operation, including:

   1) commissioning;

   2) putting system into operation after interruptions;

   3) switching the system on/number of switching cycles;

   4) operation and starting-up with closed valve;

   5) operating characteristics with increased inlet pressure;

6) special information (e.g. readiness for operation, disturbances);

d) decommissioning, including

1) switching off the system;

2) emptying and draining;

3) flushing;

4) preservation;

e) other measures.

9.3.2.4 Servicing and maintenance

The operating instructions shall include the following system servicing and maintenance instructions:

a) maintenance intervals and extent of maintenance work;

b) maintenance and inspection tasks including:

1) consumables including a list of replacement parts and special tools;

2) monitoring during operation;

3) preventive measures (e.g. for parts subject to wear, lubrication, sealing medium);

4) warning against risks arising from incorrectly set safety devices;

c) tightening torques for connecting elements;

d) criteria for selecting parts needing replacement;

e) durability of markings and warning notices.

9.3.2.5 Faults: causes and correction

The operating instructions shall include the following instructions on determining causes and corrective measures in case of faults:

a) faults, including:

1) hydrodynamic faults;

2) mechanical faults;

3) electrical faults;

4) faults in measuring instruments and their connections;

b) correction of faults, elimination of faults on the basis of a product-specific checklist.

9.3.2.6 Other technical documents

Where agreed upon by the manufacturer/authorized representative and the customer/party ordering the system, other technical documents shall be supplied together with the system.

9.3.2.7 Short-form operating instructions

In addition to the information to be provided in accordance with 9.3.1, short-form operating instructions with the following information are to be provided in a weather resistant form (legibly and indelibly) that can be readily used by operators on site. This document shall include information on:

a) Commissioning;

b) settings/operation without supervision;

c) decommissioning;

d) operating range (see sample diagram in Figure B.1 and Figure C.1).

10 Marking

10.1 The following information shall be permanently marked on the system

a) the registered name and the full address of the manufacturer and, where applicable, of the authorized agent/representative;

b) type, type test number;

c) reference to this standard and the designation (classification) of the system;

d) serial number of the system and year of manufacture;

e) mandatory marking[1)];

f) at the operating panel/operator's position, a diagram showing the system operating range;

g) also at the operating panel/operator's position, a short-form of the operating instructions.

10.2 Marking of control elements and filling devices shall be durable and legible at all times.

10.3 Lubrication and servicing points, draining devices etc. shall be identified by appropriate colours.

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1) For machines and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European Directive(s), e.g. Machinery.

Annex A
(informative)

Guideline for acceptance inspection and testing of each delivered system

When the test certificate for conformity of the product to this standard is compiled, the following should be taken into consideration:

a) When the system is being delivered to the customer acceptance tests which are based on the safety and performance requirements stated in this standard may be conducted by the customer, an independent or a national testing institution, a third-party supervision institution appointed by the customer or by the manufacturer.

b) The results of the acceptance tests should be documented.

The tests should include the following:

a) inspection of all test results and documents to verify conformity;

b) confirmation, by visual inspection and function testing, that the system specifications are met;

c) confirmation that the performance and the specifications of the system conform to the requirements of the standard;

d) confirmation that the documents specified in the standard have been supplied.

Individual details should be agreed upon.

Additional inspections and tests may be negotiated.

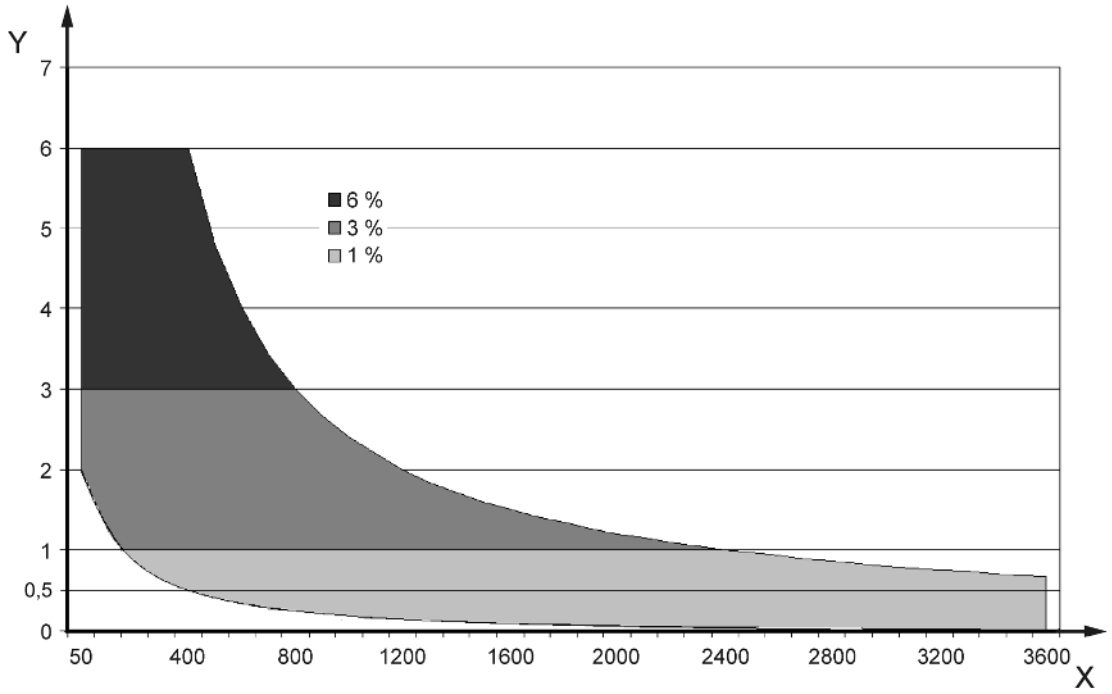
At the delivery acceptance test the manufacturer should supply devices with which the required values can be verified.

Annex B
(informative)

Sample of a positive-pressure proportioning system (PPPS) operating range diagram

Figure B.1 shows a sample diagram of the operating range of a type PPPS 2 400 positive-pressure proportioning system.

Several separate diagrams or a single diagram may be used to represent the operating range of a positive-pressure proportioning system (PPPS).



Key

X nominal foam solution delivery rate in l/min

Y dosage ratio as a percentage

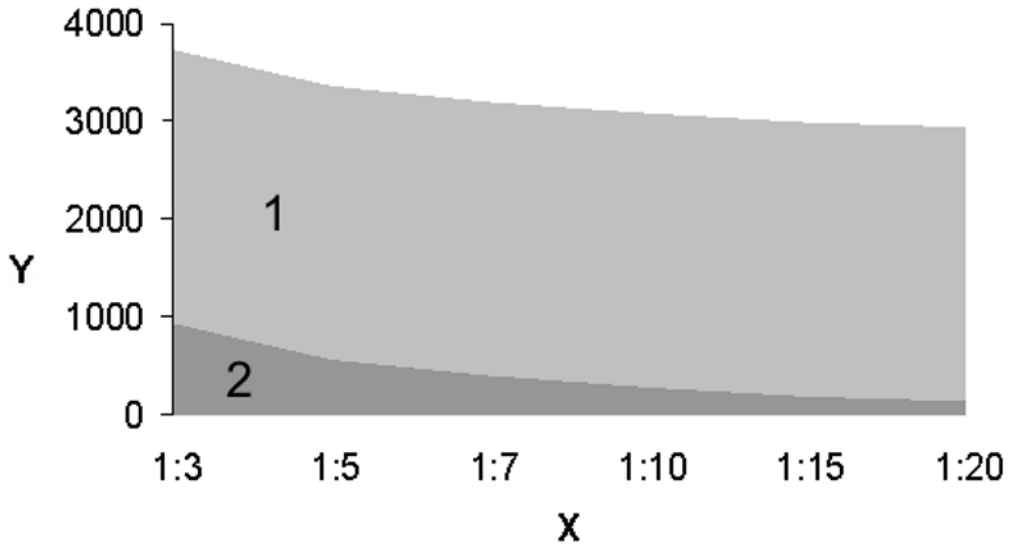
Figure B.1 — Sample diagram showing the operating range of a type PPPS 2400 positive-pressure proportioning system

Annex C
(informative)

Sample of a compressed-air foam system (CAFS) operating range diagram

Figure C.1 shows a sample diagram of the operating range of a compressed-air foam system (CAFS).

The documentation should provide sufficient information about how the results from the working-range diagram can be achieved during fire-ground operation.



Key

X adjusted ratio solution/air
Y nominal flow- rates in l/min
1 air flow
2 solution flow

Figure C.1 — Sample diagram showing the operating range of a compressed-air foam system (CAFS); maximum flows at ratio adjusted settings

Annex D
(normative)

Test Procedure for finished CAFS Foam

D.1 As the complete CAFS system is having an influence on the produced foam, this test procedure shall be used for the evaluation of finished foam during type testing of CAFS.

Further use of the procedures can be a pre-delivery test to ensure correct function of an installed system, before being delivered to the end-user. In that case, the test should be reduced to one or two guarantee points. The pre-delivery test should not fully repeat any already completed tests against this standard which have been carried out as part of the type testing.

This test procedure may also be used (or elements of it, as required) for any quantifying field tests of systems during service and maintenance, if simple visual evaluations of the produced foam are not sufficient.

D.2 The test procedure has been established in conjunction with EN 1568-3:2008, Annex G, where applicable. However the temperature test conditions according to EN 1568-3:2008, G.2 may not be maintained at all times and a nozzle suitable for compressed-air foam application shall be used instead of the nozzle described in EN 1568-3:2008, Figure G.3.

A device described in Figure D.1 (identical to EN 1568-3:2008, Figure G.1) and Figure D.2 (identical to EN 1568-3:2008, Figure G.2) shall be used to collect the finished foam. The distance between nozzle and collecting device, and the nozzle angle shall be arranged according to Figure D.3. The distance may vary to allow testing as described and shall be recorded.

D.3 The test shall be carried out with wet foam as a minimum and with dry foam if applicable. The test ratios shall be in accordance with 3.4 and 3.5. Customer and manufacturer may agree on specific test points if necessary.

If not otherwise specified by the customer, a 25 mm straight-bore nozzle is recommended to be used for this test. Straight-bore nozzles with less than 19 mm diameter shall not be used for this test,

The distance between nozzle and collecting device (centre) shall be arranged, so that the foam is collected at a point where it rains down smoothly onto the test-surface[2)] (see Figure D.3). The angle between nozzle outlet and terrain shall be recorded.

Once the system is engaged and all settings are arranged as required, foam shall be discharged away from the collection-device for 30 s and then applied to the collection device. Discharging shall be stopped once sufficient foam is collected. Evaluate drainage time according to EN 1568-3:2008, Annex G.

The procedure may be repeated with other ratio-selections as required by the customer.

The wind speed shall not exceed 1 m/s.

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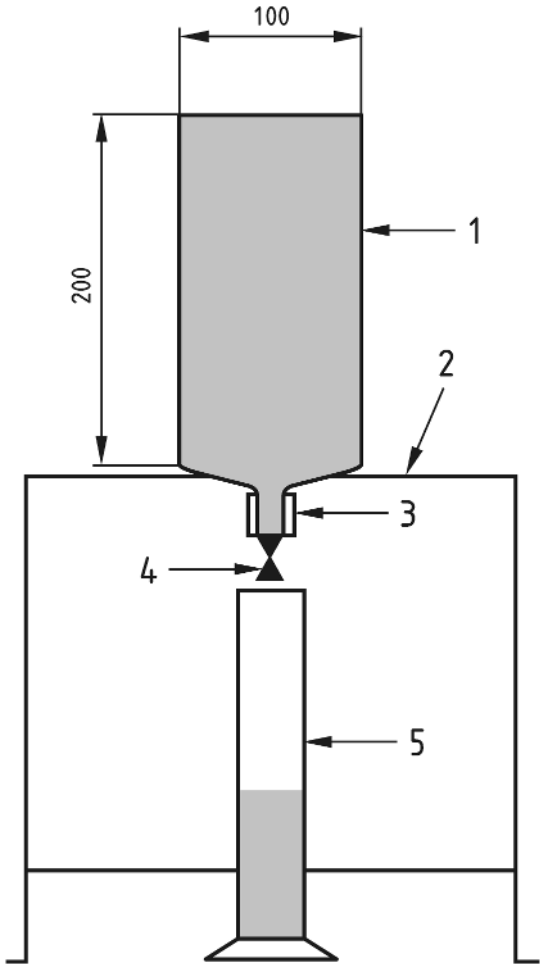
2) In case of extreme temperature-conditions (<0°C or >50°C) on the test-surface, it may be pre-conditioned before the test by water-spray.

Dimensions in millimetres

Tolerances ISO 2768-m



Key

1 drainage pot (angle of slope of base nominally 11°)

2 stand

3 transparent tube, bore: 6 mm to 8 mm, length: 30 mm to 50 mm

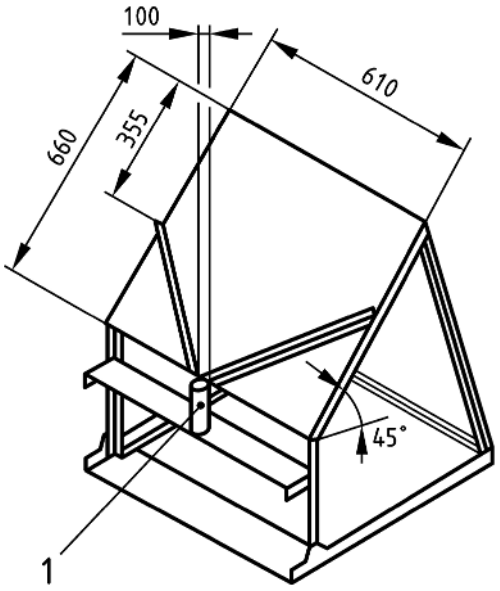
4 discharge outlet closure

5 measuring cylinder

Figure D.1 — Collecting vessel for determination of expansion and drainage time

Dimensions in millimetres

Tolerances ISO 2768-c

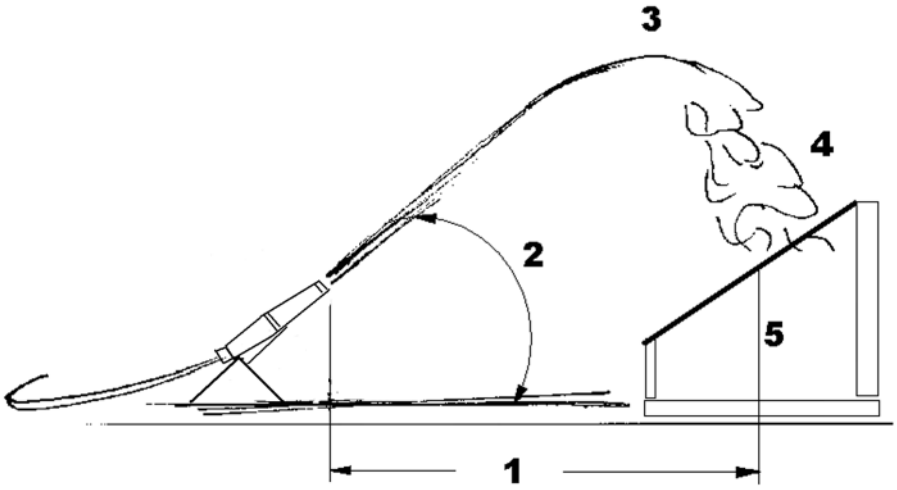


Key

1 drainage pot according to Figure D.1

NOTE Materials for the collection surface are stainless steel, aluminium, brass or plastics.

Figure D.2 — Foam collector for expansion and drainage measurement



Key

1 distance between nozzle and collecting-device
2 angle of the nozzle
3 break over
4 rain down
5 collecting device according to Figure D.2

Figure D.3 — Arrangement of nozzle and collecting-device during test

D.4 The following data shall be recorded as a minimum:

a) ambient temperature;

b) type of foam agent and dosage-rate;

c) ratio selected;

d) system operating pressure;

e) hose diameter and length used between system-discharge and nozzle;

f) type of nozzle and bore diameter;

g) distance between nozzle and collecting device;

h) angle between nozzle-outlet and ground;

i) foam solution- and air-flows during the test;

j) results of the drainage tests described;

k) any notes, observations, conditions, occurrences relevant to the test.

The records shall be kept with vehicle documentation, available for inspection by end-user or any other party responsible for an acceptance test. A series of absolutely identical installations may not require the full test procedure, however any deviations from the procedures in this Annex D shall be individually agreed between installer and customer.

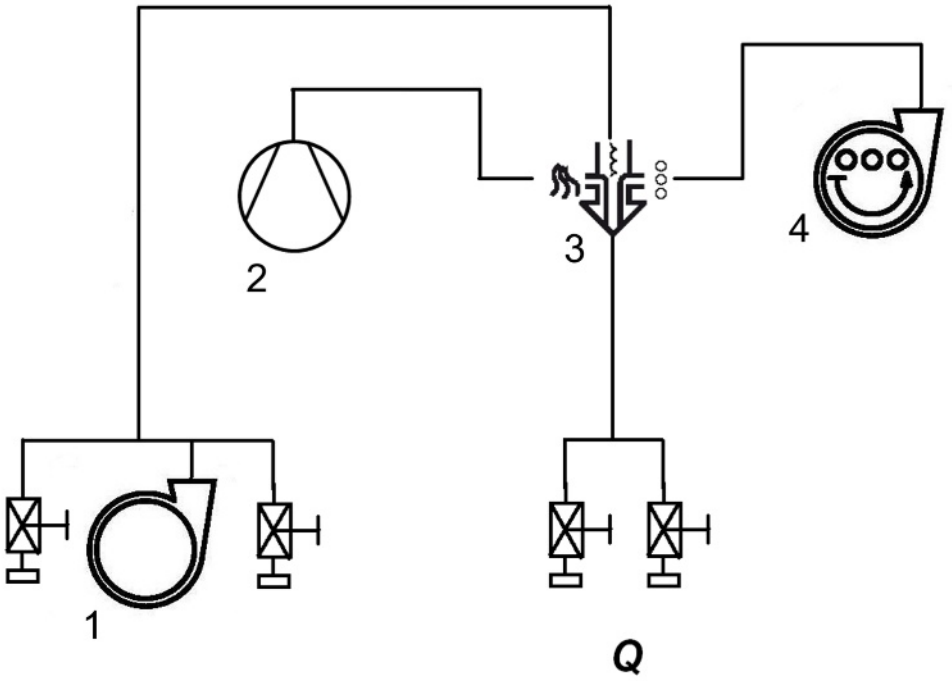
Annex E
(informative)

Technical CAFS diagrams

Figure E.1 shows a sample of a typical system diagram for CAFS with a single mixing device.

Figure E.2 shows a sample of a typical CAFS with multiple mixing devices.

The number of outlets and mixing devices are given as an example only and are not mandatory.



Key

1 fire-fighting centrifugal pump

2 air compressor

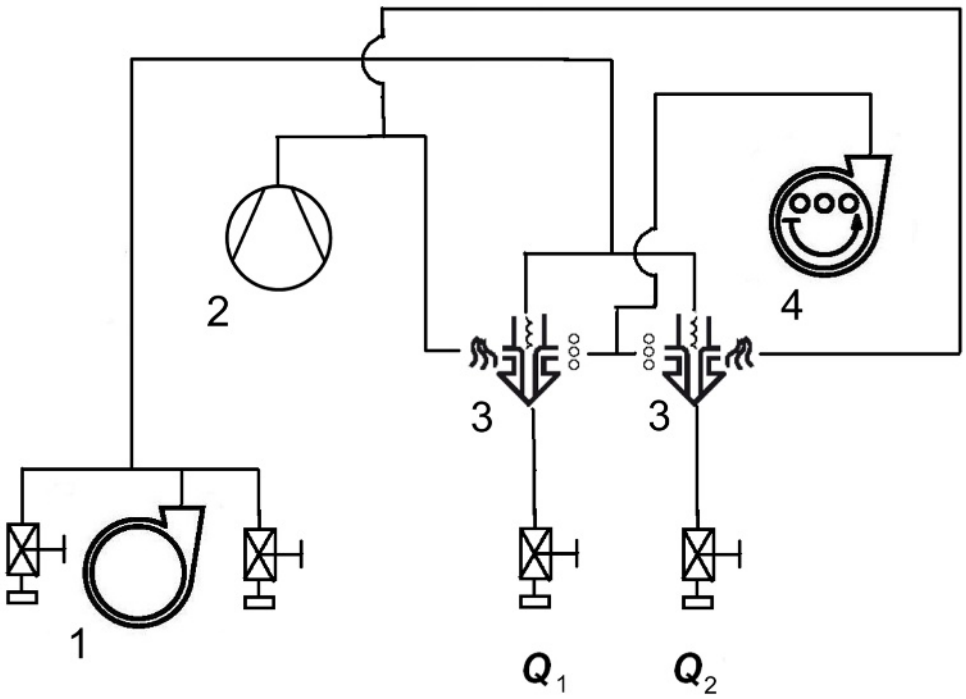
3 CAFS mixing device (schematic example)

4 foam-proportioning pump

Q solution- and air-flow

The manufacturer should provide information on nominal solution flow, nominal air flow and adjustable ratios (if applicable).

Figure E.1 — Sample of a typical system diagram for CAFS with a single mixing device



Key

1	fire-fighting centrifugal pump
2	air compressor
3	CAFS mixing device (schematic example)
4	foam-proportioning pump
Q_1, Q_2	combined solution- and air-flow through all mixing devices ($Q_1 + Q_2$)

The manufacturer should provide information on nominal solution- and air flow through each mixing device (solution and air as separate numbers), adjustable ratios (if applicable) and combined solution- and air-flow through all mixing devices ($Q_1 + Q_2$).

Figure E.2 — Sample of a typical CAFS with multiple mixing devices

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard, except Clause 7, confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive, except Essential Requirements 1.5.8 and 1.7.4.2 u), and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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[5] EN 14710-2, *Fire-fighting pumps — Fire-fighting centrifugal pumps without primer — Part 2: Verification of general and safety requirements*

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[7] EN 55012, *Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of off-board receivers*

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[9] EN 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-2)*

[10] 92/31/EEC, *Council Directive 92/31/EEC of 28 April 1992 amending Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility*

[11] 92/58/EEC, *Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work (ninth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)*

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[13] 2004/108/EC, *Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC*

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[16] ECV 1907/2006, *Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC*

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